FEBRICATION OF AUTOMATIC WALL PAINTING ROBOT

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ABSTRACT

The primary aim of the project is to design, develop and implement of Automatic WallPainting Robot which helps to achieve low cost painting process and equipment. Despite theadvance techniques in robotics and it's wide spreading application in wall painting has sharedlittle in research activities. The system performs the painting process by the use of sensorsinformation. The ultrasonic sensor mounted are on the mobile robot in a way so that the firstsensor is positioned to give vertical coordinates and the second sensor gives the horizontal coordinates.

The painting chemicals can cause hazards to the human painters such as eye and respiratorysystem problems. Also the nature of painting procedure that requires repeated work and handrising makes it boring, time and effort consuming. When construction workers and robots areproperly integrated in building tasks, the whole construction process can be better managed andsavings in human labour, timing and cost are obtained as a consequence. In addition , it offer toreduce human exposure to difficult and hazardous environments,which would solve the mostof the problemrelated to safety when many activities occurat the same time.All these factorsmotivate the development of an automatically painting robot.

Keywords: Automation in painting; Robotics; Safety; construction field ,Timer chip,

INTRODUCTION

Building and Construction is one of the major industries around the world in this fast movingconstruction industry is also growing rapidly. But the labor in construction industry are notsufficientthis insufficient labors in the construction industry is because of the difficulty in thework. In construction industry, during the work in tallbuildings or in the sites where there morerisky situation like interior area in the city. There aresome other reasons for the insufficientlabor which may be because of the improvement theeducation level which cause the people tothinkthat these types of work is not as prestigious as the other jobs.The construction industry is labor-intensive and conducted in dangerous situations; therefore importance of constructionrobotics has been realized and is grown rapidly. Applications andactivities of robotics andautomation in this construction industry started in the early 90‟s aimingto optimize equipmentoperations, improve safety, enhance perception of workspace andfurthermore, ensure quality environment for building occupant. After this, the advances inthe robotics and automation in the construction industry has grown rapidly.Fast globalization and interconnectivity create the major driving force inn creating andenhancing chance.Therefore society must acquire new trends of innovation to prosper intheir ways of life. The community has revolutionized due to the interconnectivity greatlycompared to some years back when usage of technology did not exist. Saving human labornumber and timings are only the two main advantages besides we must consider theopportunity to reduce human exposure to difficult and hazardousenvironments, improve thequality of such work which would solve with safety.

Despite the advances in the robotics and it's wide spreading applications, painting is

alsoconsidered to be difficult process as it also must paint the whole building. To make this workeasierand safer and to reduce the number of labour automation in painting introduced.The development of service robots became popular recently dur to fact that society needsrobots to relax humans from tedious and dangerous jobs in Egypt, as well as other developingcountries, the increasing population stimulates the construction-related activities such as interiorfinishing and painting. Painting is classically done by humans and generally requires exhaustivephysical efforts and involves exposureto dangerous chemicals. Chemicals can seriously impair the vision, respiratory system andgeneral health of the human painter. These factors make painting an ideal candidateprocess forautomation.

More than 100,000 apartments are built annually in Egypt, with an average painting area of 40million square meters (based on an average 100 m2 apartment area with 400 m2 painting area).The surface area of painting is more due to the renovation work and expected populationincrease in the future. This demand imposes challenges that will hardly be met using humanpainters only in the next decade.Thereforedevelopment of a Painting machine that can performthe painting task with minimum human intervention is needed and will improve the quality ofpainting. The need for an autonomous painting robot is both clear and strong.Automated painting had been realized successfully in the automotive industry to paint millions ofcars in theassembly lines. This industry uses spray painting and the robotic system is fixed inthe assembly line. The domestic painting robots should be different in the sense that robotsshould have mobility so that it can move to paint the fixed walls. Also, the domestic painterrobots should use roller instead of spray which is the commonpractice in the market to attain customer satisfaction.

This automatic wall painting robot is not designed using complicated components. This robot issimple and portable. The robot is designed using few steels, conveyor shaft,chain, rope, spraygun and a controller unit to control the entire operation of the robot the cost of project is lessbecause of simple mechanism.This robot is compact because of high speed and pressurecapabilities they have. They also have a very small weight to power output ratio and predictableperformance ie., losses are minimum and so gives expected performance. Due to elegant andsimple control system it produces less noise and vibration. It has longer life, flexibility and it isefficient and dependable, and the installation is simple and the maintenance is easy.In this mechanized word,there is a growing urge of automatic executions of almost all our work.Humans avoid getting physically involved in the taskrather than find machines to carry out ourdesignated work. Now taking of autonomous wall painting robot.

Some of the reason we wanted to Automate this process:
● To save human effort and improve throughout
● To reduce the environment risks on human lives
● To overall raise the quality of work
● To avoid hazard effect of paint on human body
● Accurate and smooth paintings
● To perform only painting in a single colour

Literature review

ShvaryaPadakar and ShrustiDevi developed a wall painting robot. which is mechanical and electronic base robot, this robot introduce motor and belt drive mechanism to drive the roller up and down. Its painting system Is roller base painting system, this robot has only one degree of freedom. This robot taking more time to paint a wall.

Karthik madhira and Sandip Mehta developed a wall painting robot , this robot is introduce the stepper motor and using belt and pully mechanism. Its painting system is generic pnumetic air brush are paint the wall, this painting robot have two degree of freedom . In this robot bluetooth module HC 05 tranciver are installed to connected with the mobile bluetooth so this robot operate with the mobile .its weight is little high approx. 40 kg. the robot paint the wall 100m*2 per hour.

MOHAMMAD T Suroor and Ahmad a Ramdan developed a roller based interior wall painting robot. Which has contain a robotic arm which have 2 degree of freedom robotic arm and three degree of freedom frame wheel. Average duration of this robot for painting a wall is 0.101 h/m2 for two layer of paint which means 10 me wall can painted in 3 hour.

Tamir is the very advance robot which is developed by Warszawsky and Y Rosenfield. Which main objective is painting, tilling and plastering. The robot has six degree of freedom and heavy weight approx 500 kg. the robot can reduce 70% painting timing. The robot has heavy weight so it is not used for residential buildings.

Mechanism

In this project there are two mechanism are use

1. Chain drive
2. Rope mechanism

    1. Chain drive- Chain drive transmitting power from motor to the shaft (1). Shaft (1) transmit the power to the shaft 2 shaft two with the help of chain drive.

    2. Rope mechanism- Rope is raped around the shaft (2) and final end of rope connected with the spray gun block. The rope is giving linear motion to the spray gun block.

Working principle

The robot is operating by the remote. A motor is installed on the frame , chain transmit the power from motor to the shaft[1] and shaft [1] is transmit the power to the shaft [2] where a rope is rapped on the shaft [2].one end of the rope connected with the spray gun block. When the motor rotate clockwise the spray gun block going to the downward direction. When the motor rotate anticlockwise direction with the help of timer chip the spray gun block going in upward direction. A timer chip are use for rotating the motor clockwise or anticlockwise in given time. Movement of the robot done by the wheel which operate with motor. whole system is controlled by the microcontroller.

Main components

Components of wall painting robot mainly two part-

1. Mobile platform
   1. Frame
   2. Wheel
   3. Microcontroller'
   4. Battery
   5. Motor
2. Spray gun mount
   1. Spray gun
   2. IR sensor
   3. Flow control valve

Mobile platform

1. **Frame-**It is a main part of this project in which every function of the machine will work. All the available equipmentwho is connected to each other, will move anywhere near to the wall. Length of the frame is 1 m and width is 0.75 m.
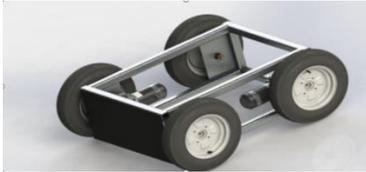
2. **Wheel-**wheel is the moving part of the project which carry total weight of the project. For the movement of wheel to DC gear motor are installed which is connected with the battery. Wheel are controlled by the microcontroller.

3. **Microcontroller-**MCU is a small integrated chip which contain one or more CPU and programmable input/output. In this project MCU controlled all movement of the project. MCU connected with the IR sensor, IR sensor sense the wall and give information to the MCU, MCU give the direction for movement to the wheel.

4. **Battery-** batter is a device which contain one or more electrochemical cell. Battery giving the power to the project. In this project 3 battery are use which voltage is 12 vol t. 2 battery are installed for the movement of wheel and one battery are installed for rotating the motor.

5. **Motor-** Motor is a device which converting electrical energy into mechanical energy. In this robot motor is giving power to the shaft(1) by using chain drive then shaft (1) giving power to the shaft (2). On the shaft (2) one wire will rapped and one end of the wire spray gun block which doing liner motion.

   Specification
   ➤ Power-5watt, 12volt
   ➤ Torque-0.24525 Nm
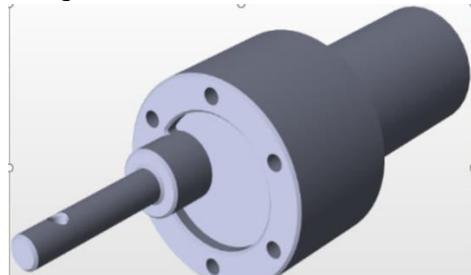
6. **Timer chip-**it is the 555 intigreted chip which is use for controlling the rotation of the motor. Timer IC used to provide time delay, oscillator and as a flip-flop element. It rotate the motor into clockwise and anticlockwise.
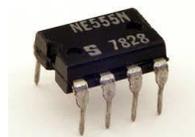

Spray gun mount

1. **Spray gun-**This process occurs when paint is applied to an object through the

use of an air-pressurized spray gun. The air gun has a nozzle, paint basin, and air compressor. When the trigger is pressed the paint mixes with the compressed air stream and is released in a fine spray.

## Specification:-

Air Pressure = 35psi, Nozzle size = 1 mm
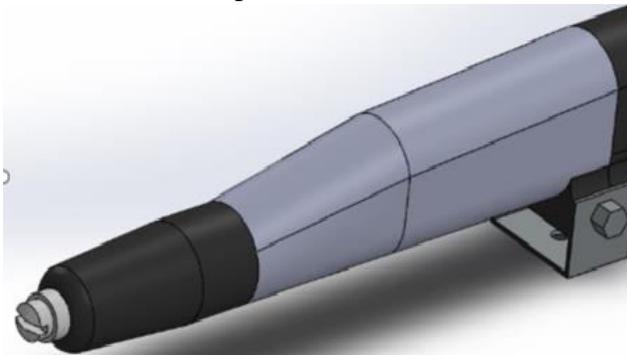
2. **IR sensor-**IR sensor is used for this project. IR (infrared) is the typical light source being used in the sensor for robot to detect object. Basic principle of IR sensor is based on an IR emitter and an IR receiver.
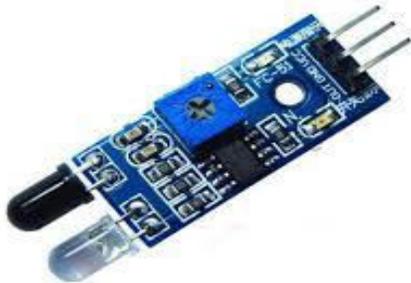
3. **Flow control valve-**flow control valve is a device which is use for controlling pressure of the fluid.

LINE DIAGRAM OF THE PROJECT
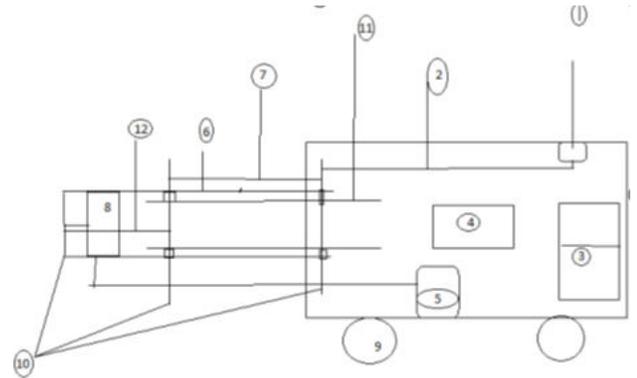
1.   Motor

2.   Chain

3.   Battery

4.   Arduino

5.   Compressor

6.   Guider

7.   Chain

8.   Spray gun block

9.   Wheel

10. Shaft

11. Guider

12. Wire Rope

CALCULATION

Formula of finding diameter of rope

$$SWL(kg)=D2*8$$

$$SWL(kg)=8$$

D=30 mm

Length= 1.25 meter

D= diameter of rope

SWL= safety work load

Time duration painting of wall

1m length and 2 cm width in 2 second

3 second for moving wheel

Total 1 m length and 2 cm width in 5 second

Area= $1*0.02=0.02m2=0.004m2/s$

That mean $0.004*60=0.24m2/min$

That mean $0.24*60=14.4m2/h$

Conclusion

Our project has described the automatic wall painting robot. The robot is light weight and small size which can easily handled. The robot has contain one spray gun which suck the paint with the help of compressor and spray on the wall. It is smooth functioning robot. The above robot made by us is a prototype of the robot with some further modification we also use the robot in use of water spray on the wall. Further we can also use for glass cleaning robot.

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